Alternating Drainfields

Recommended Standards and Guidance for
Performance, Application, Design and Operation & Maintenance

Washington State Department of

Health

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Preface

The recommended standards contained in this document have been developed for statewide application. Regional differences may, however, result in application of this technology in a manner different than it is presented here. In some localities, greater allowances than those described here may reasonably be granted. In other localities, allowances that are provided for in this document may be restricted. In either setting, the local health officer has full authority in the application of this technology, consistent with Chapter 246-272 WAC and local jurisdictional rules. If any provision of these recommended standards is inconsistent with local jurisdictional rules, regulations, ordinances, policies, procedures, or practices, the local standards take precedence. Application of the recommended standards presented here is at the full discretion of the local health officer.

Local jurisdictional application of these recommended standards may be:

1) **Adopted as part of local rules, regulations or ordinances—**When the recommended standards, either as they are written or modified to more accurately reflect local conditions, are adopted as part of the local rules, their application is governed by local rule authority.

2) **Referred to as technical guidance in the application of the technology—**The recommended standards, either as they are written or modified to more accurately reflect local conditions, may be used locally as technical guidance.

Application of these recommended standards may occur in a manner that combines these two approaches. How these recommended standards are applied at the local jurisdictional level remains at the discretion of the local health officer and the local board of health.

The recommended standards presented here are provided in typical rule language to assist those local jurisdictions where adoption in local rules is the preferred option. Other information and guidance is presented in text boxes with a modified font style to easily distinguish it from the recommended standards.

Acknowledgements—

The Department of Health Wastewater Management Program appreciates the contribution of many persons in the on-going development, review, and up-dating of the Recommended Standards and Guidance documents. The quality of this effort is much improved by the dedication, energy, and input from these persons, including:

- Geoflow, Inc.
- Lombardi and Associates
- Orenco Systems, Inc.
- Puget Sound Water Quality Action Team
- Sun-Mar Corporation
- Washington State On-Site Sewage Association (WOSSA)
- Washington State On-Site Sewage Treatment Technical Review Committee (TRC)
- Waste Water Technologies

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Introduction—

Typical on-site sewage systems consist of a septic tank and a gravity flow, gravel-filled drainfield, with a designated drainfield replacement area set aside and protected for future use. Effluent from the septic tank is distributed to the drainfield, where it is dispersed to, and is treated in, the soil. Wastewater treatment in the soil is enhanced when flow through the soil occurs in unsaturated conditions. Bacteriological treatment occurs mostly on the surface of soil particles. When wastewater flow occurs in saturated conditions, the space between soil particles is occupied by wastewater, some of the wastewater travels faster, farther, and deeper. These conditions reduce the treatment capacity of this soil-based on-site sewage treatment system.

The rate at which wastewater infiltrates to the soil depends upon the volume and character of the wastewater and the texture and structure of the soil. Depending on the interplay of these factors a biomat begins to form at the soil interface. This is a normal condition that occurs over time in nearly all drainfields, with both positive and negative impacts.

The general pattern of biomat development begins when the combination of wastewater flow and the load of suspended solids overwhelm the infiltrative capacity of the soil at the bottom of the trench. Wastewater accumulates or ponds above the infiltrative surface, inducing a zone of anaerobic conditions, leading to biomat development. This is a progressive event, leading in time to the development of a flow-restricting biomat over the entire trench-bottom infiltrative surface. As ponding continues to increase, the trench sidewall infiltrative surfaces become involved with the biomat development and the resulting regulation of wastewater flow into the surrounding soil. The anaerobic conditions induced by the ponding wastewater contribute to a thicker, denser biomat, which in turn further retards wastewater flow. In most drainfields a point of equilibrium is achieved, with a well-developed biomat that is in balance with the wastewater flow into the system and the soil which surrounds the drainfield. Over time, however, this condition of equilibrium may be upset, resulting in drainfield failure.

On the positive side, the developing biomat retards the flow of wastewater, contributing to unsaturated soil conditions below the drainfield, which are conducive to improving wastewater treatment. Without an established biomat to regulate wastewater flow into the surrounding soil, saturated flow conditions exist at and below the drainfield trench bottom infiltrative surface. These saturated flow conditions, as explained above, reduce the treatment efficiency of the soil below and around the drainfield. On the negative side, particularly in finer textured soils, the biomat can be come so restrictive the drainfield exhibits continual and increasing ponding conditions that may result in drainfield failure.

Integrating the design elements of alternating drainfields into an on-site sewage system provides at least two normally sized drainfields, separated by a switching valve so that each drainfield can alternately be used and rested. These two drainfields constitute the initial and replacement drainfields, eliminating the need to designate an additional reserve area. Periodically the valve is switched and the second drainfield is placed into use while the first one is allowed to rest. This resting period allows the drainfield to completely drain and the biomat at the soil interface to dry. Aerobic conditions then exist aiding the oxidation of the biomat, allowing the soil to renew its absorptive capacity. *(See Figure 1)*

The goal of all on-site sewage systems is to provide wastewater treatment for the life of the facility served. Managing the development and existence of the biomat in the drainfield can contribute greatly to both the treatment performance and the lifespan of the drainfield system. The value of the alternating drainfield design is more easily realized in fine textured soils, Soil Types 3 through 6, as opposed to the coarser textured soils, Soil Types 1A, 1B, 2A, & 2B. The use of alternating drainfields in coarse soils may be counter-productive, particularly in terms of wastewater treatment. The development of a biomat in the drainfield is a positive condition even though too much of good thing can lead to problems. In coarse-textured soils the biomat is much slower to develop than in fine textured soils. During the time it takes to develop a biomat in coarse soils, wastewater flow in the soil below the drainfield is often under saturated flow conditions, which reduce the wastewater treatment capacity of the system. If alternating drainfields are used in this setting, an annual succession of slowly developing biomats can ensue in each of the drainfields. The two drainfields perform well hydraulically (disposing of the wastewater) but poorly in terms of treating the wastewater.

One approach to addressing the slow or poor development of a flow-restricting biomat in medium-to-coarse soils is the use of pressure distribution. The design nature of pressurized drainfield systems, that of frequent dosing of small volumes of wastewater uniformly throughout the drainfield simulates the flow-restrictive nature of a well-developed biomat. This is why in coarse soils the on-site rules require the use of pressure distribution: the mechanical system of pressurizing and dosing replaces the biomat as a flow regulator in these soils where the natural development of a biomat is slow and unsure. For long-term management of wastewater treatment and disposal, alternating drainfields link very well with pressure distribution.

In all soil conditions the frequency of valve switching depends upon the rate of biomat development, which in turn is dependent upon biological load and hydraulic flow of the wastewater being treated and disposed at the site. As mentioned earlier a well-developed, flow-regulating biomat is an important element in the treatment capacity of the on-site sewage system drainfield. This is particularly true in systems using gravity flow distribution, less true in systems using pressure distribution. Generally, a biomat will form more slowly in coarse soils and when the hydraulic or biologic load on the system is low. When the soils are of a finer texture or when the hydraulic or biologic load on the system is high, the biomat will for more quickly. In any case, proper management of the biomat—development, existence, and resting/drying—is based upon observations of the drainfield ponding levels. These routine observations will lead the operator to select a valve switching schedule or frequency that matches the particular system site, soil, and wastewater characteristics. Such an approach, depending upon conditions, could result in a relatively frequent valve switching cycle (every six months) to a relatively infrequent valve switching cycle (every 3 or 4 years).

The alternating drainfield system incorporates two elements of equal importance: 1) the physical capacity to switch from one drainfield to another, and 2) operation and maintenance of the system, regularly observing the condition of the biomat and ponding levels. Together these elements allow for complete long-term management of wastewater treatment and disposal. Contrast this with the more common approach to long-term management of septic tank and drainfield systems:

1. The on-site sewage system, with the initial drainfield and replacement drainfield area designed, is installed and put into use.

2. The system is used, hopefully properly operated and maintained, and over time (hopefully greater than 15 years), the capacity of the drainfield to infiltrate wastewater into the soil is exceeded, due largely to biomat development that restricts wastewater flow to a degree that upsets the system equilibrium.

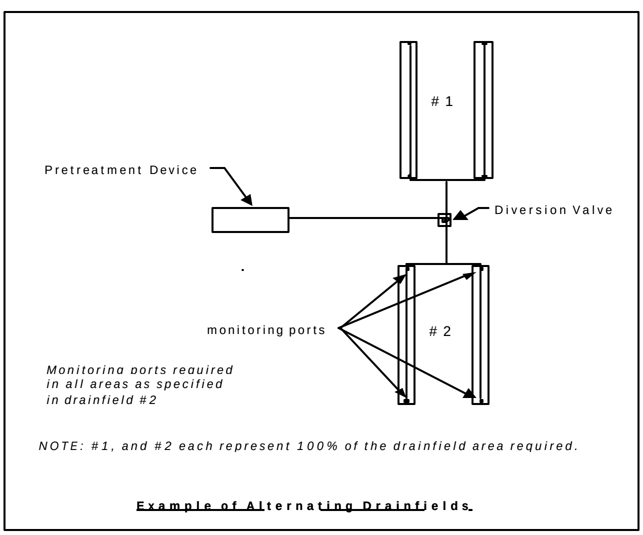
3. The reserve area is used for the installation of a repair / replacement drainfield. The initial drainfield is abandoned. (Commonly involving great expense and the destruction of long-established landscaping and plants, shrubs and trees.)

4. Step 2 is repeated.

When alternating drainfields are properly managed the long-term treatment performance and disposal capacity of the system is enhanced. An additional advantage of alternating drainfields, is that by initially installing and routinely using both drainfields (synonymous with the initial and the replacement drainfields in the scenario described above) future expensive system repair / replacement and the negative impact to landscape, turf, shrubs and trees is avoided.

A word of caution may be in order here, in that if alternating drainfields are managed in the same way as the four steps above describe for the typical approach to long-term management of septic tank and drainfield systems, the results will be the same. That is if the first drainfield is used until it fails at which time the second is put into service, rather than applying prudent O&M and management of wastewater flow to the drainfields the system owner is robbed of the system's inherent design benefits. There is a functional (and probably a significant lifespan) difference between installing and properly operating alternating drainfields and simply "pre-installing" the repair / replacement drainfield. For this reason in those settings where the initial and replacement drainfields are installed together, operating the two-drainfield system as alternating drainfields is preferred. This approach may also decrease the potential for detrimental uses of the reserve drainfield area over time if the 2nd drainfield is not placed into regular / sequential service.

Figure 1. Alternating Gravity-flow Drainfield



1. **Performance Standards—**Alternating drainfields provide an on-site sewage treatment and disposal system with the capacity to alternately use one of two drainfields installed as the initial system. Each of the two component drainfield parts are designed, sized and installed to treat and dispose of the anticipated daily sewage flow and incorporate a means of diverting flow to either one (not both) of the drainfields. Operation and maintenance of the system includes the evaluation of when to switch from one field to the other as a means to manage the biomat at or near equilibrium (of wastewater into and out of the drainfield).

2. **Application Standards—**

2.1. Soil Type Conditions—Alternating drainfields may be used:

2.1.1. In Soil Types 3 through 6, with either gravity or pressure distribution.

2.1.2. In Soil Types 1A & 2A, only with pressure distribution. (Pretreatment to Treatment Standard 2 levels may be required. WAC 246-272-11501.)

2.2. Influent Characteristics—

2.2.1. Residential Wastewater: Alternating drainfields are designed for treating residential strength wastewater. The wastewater applied to drainfields must not be higher in strength than 230 mg/l BOD_5 or 145 mg/l TSS (no TSS particles should be retained on a 1/8-inch mesh screen). Lowering wastewater strengths, without increasing flow rates is preferable for assuring long term operation of a drainfield system.

2.2.2. Non-Residential Wastewater: High-strength wastewater and wastewater from non-domestic sources (such as restaurants, hotels, bed and breakfast establishments, and other commercial wastewater sources, etc.) must be individually evaluated for treatability and degree of pretreatment required prior to distribution to the alternating drainfields for final treatment and disposal.

2.3. Pretreatment—

2.3.1. If the wastewater is residential sewage, settleable and floatable solid separation by a properly sized two-compartment septic tank with effluent baffle screening will suffice. All septic tanks must be designed in compliance with Washington State On-Site Sewage System Regulations (WAC 246-272-11501(2)(d)). Pretreatment with some other approved sedimentation/initial treatment unit (such as an ATU—Aerobic Treatment Unit) may be used instead of a septic tank.

2.3.2. If the wastewater is from a non-domestic source, influent to the alternating drainfield must be equivalent to residential strength septic tank effluent. Aerobic treatment or some other treatment process may be needed to modify the influent to the drainfields to within the range of residential septic tank effluent quality.

2.4. Listing— Alternating drainfields are a generic technology and therefore is not listed in the department's <u>List of Approved Systems and Products</u>. Alternating drainfields may be permitted by local health officers as there is a DOH guidance document available (this document).

2.5. Permitting—

2.5.1. An installation permit and an operational permit (if required by the local health jurisdiction) must be obtained from the appropriate local health officer prior to installation and use. These permits or other system-related documents (such as inspection reports or as-built drawings & specifications) must include information about the need for routine operation and maintenance including annual inspection to properly manage the switching from one drainfield to another.

3. Design Standards—

3.1. Drainfield Sizing—Each segment of an alternating drainfield (drainfield #1 and drainfield #2) must be sized at 100% of the drainfield required to match the estimated daily design flow with the Soil Type at the site.

3.2. Reserve Area—With the installation of two drainfields (#1 & #2), additional reserve area is not required.

3.3. Drainfield Type / Technologies—Either gravel-filled or gravelless drainfield technologies may be used in alternating drainfield systems.

3.4. Distribution Methods—Either gravity flow or pressure distribution may be used. Pressure distribution is required in Soil Types 1A & 2A, and in Soil Types 1B, 2B, 3 through 6 when vertical separation is less than three (3) feet. When pressure distribution is used, design information may be obtained in the DOH Recommended Standards and Guidance for Pressure Distribution.

3.5. Effluent Screens—The septic tank must be fitted with an effluent screen to prevent the passage of suspended solids large enough to foul the diversion valve.

3.6. Diversion Valves—All diversion valves regardless of the type of distribution used (gravity or pressure) must:

3.6.1. Provide for independent flow to drainfield #1 or #2, but not both.

3.6.2. Be fitted with risers and watertight lids or covers, extending to grade, which will permit unobstructed access for maintenance, inspection, and operation.

3.6.3. Have a valve box and either suitable length valve stems or long-handled keys or tools so that they may be easily operated from the ground surface.

3.7. Observation Ports—Observation ports must be installed to the level of the trench-bottom infiltrative surface in each drainfield line so that the levels of ponding can be observed.

4. Operation and Maintenance Standards—

4.1. General—

4.1.1. The owner of the residence or facility served by the alternating drainfield system is responsible for assuring proper operation and providing timely maintenance for all components of the on-site wastewater treatment and disposal system.

4.1.2. The on-site wastewater system designer must instruct, or assure that instruction is provided to, the owner of the residence or facility regarding proper operation of the entire on-site wastewater system. This instruction should emphasize regular observation of the conditions of the drainfield (including observations of ponding levels within the drainfield lines).

4.1.3. Alternating drainfields must be monitored and maintained at a frequency commensurate with the site, soil, system complexity and use patterns.

4.2. O&M activities include—

4.2.1. Septic and Pump Chamber Inspection Items—

(a) Observe sludge and scum accumulations; pump as necessary.
(b) Check condition of effluent screen for clogging, damage, and proper placement. Clean each time it is inspected or as needed.
(c) Look for signs of leaking in tanks and risers. Repair or replace if necessary.
(d) Check that risers and lids are in good condition and that the lids are securely fastened.
(e) If pressure distribution is used:

- ♦ Measure pump run time per cycle and drawdown. Compare with time recorded in as-built.
- ♦ Test alarms for proper functioning (high and low liquid level).
- ♦ Check for properly function of floats. Movement should not be restricted. Floats should be positioned correctly and provide positive instrumentation signals. Adjust and repair as necessary.

4.2.2. Distribution Device Inspection Items—If a distribution box is used to distribute wastewater to individual lines in the drainfield, and if it is accessible, inspection must include the following items:

(a) Uneven settling of d-box
(b) Levelness of inverts of outlets of d-box
(c) Uniformity of outlet flow of d-Box

4.2.3. Diversion Valve Inspection Items—

(a) Check the diversion valve for proper placement to assure that wastewater is being diverted to the correct drainfield in proper sequential order.

4.2.4. Drainfield Protection Efforts—

(a) Assure that no surface water collects on the drainfield site.
(b) Prohibit any type of vehicular or livestock traffic over the drainfield area.
(c) Prohibit the construction of decks or buildings, or the placement of impervious materials or surfaces over the drainfield site.
(d) Maintain a suitable, non-invasive shallow-rooted vegetative cover over the drainfield site.

4.2.5. Drainfield Inspection Items — Inspecting / observing the entire on-site sewage system must be done at least once a year. This may be done by the homeowner or other persons, depending upon the provisions of the local health jurisdiction permit. Items to look for include:

(a) Indication of surfacing effluent.
(b) Abnormal settling or erosion.
(c) Ponding of wastewater in the drainfield (check via the Observation Ports).

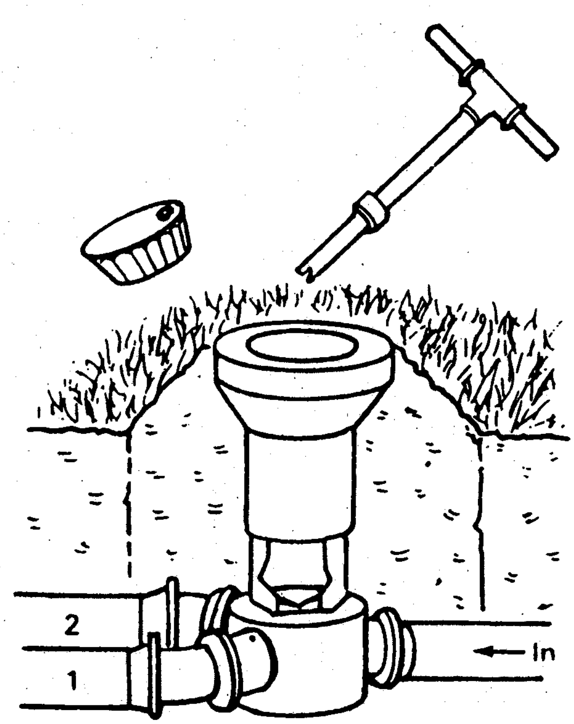
4.3. Observed Conditions / Actions — The general system management approach to alternating drainfields is to switch from one drainfield to the other on a calendar basis, usually at the same time each year. However, if observations reveal continuous and increasing ponding levels that if left unresolved will probably result in drainfield failure, appropriate action must be taken. Appropriate action may include:

4.3.1. Switching from one drainfield to the other.
4.3.2. Modifications or changes within the structure relative to wastewater strength or hydraulic flows.

4.4. Routine Servicing — Servicing all system components as needed, including product manufacturer's requirements / recommendations for service.

Proper operation of an alternating drainfield system requires that the flow be diverted from one segment to the other. Each segment should be allowed to rest for periods of six to 12 months before being put back into use, depending upon the degree of biomat development, which is dependent on wastewater conditions of flow volume and strength, and the Soil Type present in the drainfield area. Records of inspections, dates of flow diversions, and system design should be kept in a location where they are easily retrievable.

Figure 2. Typical Diversion Valve



Appendix A

Definitions —

Alternative System: an on-site sewage system other than a conventional gravity system or conventional pressure distribution system. Properly and maintained alternative systems provide equivalent or enhanced treatment performance as compared to conventional gravity systems.

Approved List: "List of Approved Systems and Products", developed annually and maintained by the department and containing the following:

(a) List of proprietary devices approved by the department;
(b) List of specific systems meeting Treatment Standard 1 and Treatment Standard 2;
(c) List of experimental systems approved by the department;
(d) List of septic tanks, pump chambers, and holding tanks approved by the department.

Conventional Gravity System: an on-site sewage system consisting of a septic tank and a subsurface soil absorption system with gravity flow distribution of the effluent.

Disposal Component: a subsurface absorption system (SSAS) or other soil absorption system receiving septic tank or other pretreatment device and transmitting it into original, undisturbed soil.

Diversion Valve: a valve that diverts flow exclusively to one disposal component providing a long-term drying period of another disposal component.

Drainfield (conventional): an area in which perforated piping is laid in drain rock-packed trenches, or excavations (seepage beds) for the purpose of distributing the effluent from a wastewater treatment unit.

Effluent: wastewater discharged from a septic tank or other on-site sewage system component.

Experimental System: any alternative system without design guidelines developed by the department or a proprietary device or method which has not yet been evaluated and approved by the department.

Failure: a condition of an on-site sewage system that threatens the public health by inadequately treating sewage or creating a potential for direct or indirect contact between sewage and the public. Examples of failure include:

(a) Sewage on the surface of the ground;
(b) Sewage backing up into a structure caused by slow absorption of septic tank effluent;
(c) Sewage leaking from a septic tank, pump chamber, holding tank, or collection system;
(d) Cesspool or seepage pits where evidence of ground water or surface water quality degradation exists; or
(e) Inadequately treated effluent contaminating ground water or surface water.
(f) Noncompliance with standards stipulated on the permit.

Final Treatment/Disposal Unit: that portion of an on-site sewage system designed to provide final treatment and disposal of the effluent from a wastewater treatment unit, including, but not limited to, absorption fields (drainfields), sand mounds and sand-lined trenches.

Infiltrative Surface: in drainfields, the drain rock-original soil interface at the bottom of the trench; in mound systems, the gravel-mound sand and the sand-original soil interfaces; in sand-lined trenches/beds (sand filter), the gravel-sand interface and the sand-original soil interface at the bottom of the trench or bed.

Influent: wastewater, partially or completely treated, or in its natural state (raw wastewater), flowing into a reservoir, tank, treatment unit, or disposal unit.

On-site Sewage System (OSS): an integrated arrangement of components for a residence, building, industrial establishment or other places not connected to a public sewer system which:

(a) Convey, store, treat, and/or provide subsurface soil treatment and disposal on the property where it originates, upon adjacent or nearby property; and

(b) Includes piping, treatment devices, other accessories, and soil underlying the disposal component of the initial and reserve areas.

Proprietary Device or Method: a device, or method classified as an alternative system, or a component thereof, held under a patent, trademark or copyright.

Pump Chamber: a tank or compartment following the septic tank or other pretreatment process that contains a pump, floats, and volume for storage for effluent. If a siphon is used, in lieu of a pump, this is called a "siphon chamber".

Residential Sewage: sewage having the consistency and strength typical of wastewater from domestic households.

Septic Tank: a watertight pretreatment receptacle receiving the discharge of sewage from a building sewer or sewers, designed and constructed to permit separation of settleable and floating solids from the liquid, detention and anaerobic digestion of the organic matter, prior to discharge of the liquid.

Sewage: any urine, feces, and the water carrying human wastes including kitchen, bath, and laundry wastes from residences, building, industrial establishments or other places. For the purposes of these guidelines, "sewage" is generally synonymous with domestic wastewater. Also see "residential sewage."

Soil Type 1A: very gravelly coarse sands or coarser, extremely gravelly soils.

Subsurface Soil Absorption System - "SSAS": a system of trenches three feet or less in width, or beds between three feet and ten feet in width, containing distribution pipe within a layer of clean gravel designed and installed in original, undisturbed soil for the purpose of receiving effluent and transmitting it into the soil.

Suitable Soil: original, undisturbed soil of types 1B through 6.

Treatment Component: a class of on-site sewage system components that modify and/or treat sewage or effluent prior to the effluent being transmitted to another treatment component or a disposal component. Treatment occurs by a variety of physical, chemical, and/or biological means. Constituents of sewage or effluent may be removed or reduced in concentrations.

Treatment Standard 1: A thirty-day average of less than 10 mg/l of BOD_5 and 10 mg/l of total suspended solids and a thirty-day geometric mean of less than 200 fecal coliform/100ml.

Treatment Standard 2: A thirty-day average of less than 10 mg/l of BOD_5 and 10 mg/l of total suspended solids and a thirty-day geometric mean of less than 800 fecal coliform/100ml.

Vertical Separation: the depth of unsaturated, original, undisturbed soil of Soil types 1B - 6 between the bottom of a disposal component and the highest seasonal water table, a restrictive layer, or Soil Type 1A.

Wastewater: water-carried human excreta and/or domestic waste from residences, buildings, industrial establishments or other facilities. (See SEWAGE.)

Wastewater Design Flow: the volume of wastewater predicted to be generated by occupants of a structure. For residential dwellings, this volume is calculated by multiplying the number of bedrooms by the estimated number of gallons per day (GPD), using either the minimum state design standard (120 GPD) or the locally established minimum standard (such as 150 GPD).